DOCUMENT RESUME

ED 219 948 FL 013 134

AUTHOR Ornstein-Galicia, Jacob L.; Penfield, Joyce
TITLE A Problem-Solving Model for Integrating Science and Language in Bilingual/Bicultural Education. Bilingual Education Paper Series, Vol. 5, No. 1.
INSTITUTION California State Univ., Los Angeles. Evaluation, Dissemination and Assessment Center.
PUB DATE Aug 81
NOTE 32p.
AVAILABLE FROM Evaluation, Dissemination and Assessment Center, California State University, 5151 State University Drive, Los Angeles, CA 90032 ($2.00).

EDRS PRICE MF01/PC02 Plus Postage.
DESCRIPTORS Biculturalism; *Bilingual Education; Bilingualism; Elementary Education; English (Second Language); Experiential Learning; *Immersion Programs; Material Development; *Mexican American Education; Models; *Science Activities; *Second Language Instruction; *Spanish; Teacher Developed Materials; Teaching Methods
IDENTIFIERS *United States (Southwest)

ABSTRACT

An integrated bilingual science instruction model is described. Intended primarily for Spanish-speaking children in the Southwest, it specifies how the dominant language skills and the second language might be synchronized and be mutually supportive with science learning in a way relevant to the Latino culture. For purposes of discussion and clarification, the integrative model is contrasted with three hypothetical models: the transfer, the balanced bilingual, and the ESL models. It is argued that a problem-solving approach to science instruction with the proper hands-on activities could improve the bilingual/bicultural program by: (1) focusing more on cognitive operations of science; (2) involving the children in actual problem-solving thought processes; and (3) improving skills in both languages. More specifically, the model spells out how skills in both languages can be used in a basically immersion approach, that is, an approach which uses science-oriented materials to teach the second language. Further, the model is directed toward teaching both English and Spanish as second languages through science instruction. Because there is a lack of bilingual science materials appropriate for Southwest Spanish speakers, it is suggested that teachers develop materials from hands-on materials written in English for teacher use. Suggestions are made for this procedure as well as for creation of materials by the teacher. (Author/AMH)

****
* Reproductions supplied by EDRS are the best that can be made *
* from the original document. *
****

ISSN 0161-3707

Vol. 5 No. 1
August 1981

ED219948

Bilingual Education PAPER SERIES

A PROBLEM-SOLVING MODEL FOR INTEGRATING SCIENCE AND LANGUAGE IN BILINGUAL/ BICULTURAL EDUCATION

Jacob L. Ornstein-Galicia
Joyce Penfield
University of Texas at
El Paso

Evaluation, Dissemination and Assessment Center
California State University, Los Angeles
5151 State University Drive
Los Angeles, CA. 90032

U.S. DEPARTMENT OF EDUCATION
NATIONAL INSTITUTE OF EDUCATION
EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)

☒ This document has been reproduced as received from the person or organization originating it.
☐ Minor changes have been made to improve reproduction quality.

• Points of view or opinions stated in this document do not necessarily represent official NIE position or policy.

"PERMISSION TO REPRODUCE THIS MATERIAL HAS BEEN GRANTED BY
Evaluation Dissemination & Assessment Center
TO THE EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)."

FL013134

The subject of this publication was supported in whole or in part by the United States Education Department. The opinions expressed herein do not necessarily reflect the position or policy of the United States Education Department; no official endorsement by the United States Education Department should be inferred.

This publication was printed with funds provided by the Bilingual Education Act, Title VII of the Elementary and Secondary Education Act of 1965, as amended by Public Law 93.380.

A PROBLEM-SOLVING MODEL FOR INTEGRATING SCIENCE AND LANGUAGE IN BILINGUAL/BICULTURAL EDUCATION*

Jacob L. Ornstein-Galicia
Joyce Penfield

ABSTRACT

This paper describes a model that would take into account ethnolinguistic differences in the bilingual science classroom and would not sacrifice one language at the expense of the other. It further suggests how a problem-solving approach to science instruction with the proper hands-on activities could improve the bilingual/bicultural program by: (1) focusing more on cognitive operations of science, (2) involving the children in actual problem-solving thought processes, and (3) improving language skill in both languages. More specifically, the proposed integrative model spells out how language skills in L1 and L2 can be synchronized and mutually supportive with science learning in a way relevant to Latino culture. Finally, this paper suggests ways in which the proposed model can be utilized in the creation of classroom materials either through adaptation of available materials or the creation of teacher-made materials of the hands-on type.

INTRODUCTION

In recent decades science education has shifted from an emphasis on memorization of facts to a process-approach to the

---

*This paper will appear in Winter, 1982 as Joyce Penfield and Jacob L. Ornstein-Galicia, "Language through Science: An Integrative Model," **Ethnoperspectives in Bilingual Education Research: Bilingual Education Technology**, ed. Raymond Padilla (Ypsilanti, Michigan: Eastern Michigan University).

mastery of scientific principles. This current orientation in science education is due in large measure to the influence of Montessori and Piaget, who have influenced pedagogy indirectly to incorporate the utilization of inquiry through observation, experimentation, and discovery of generalizations (Agnello, 1980).

At least two main factors are involved in bilingual/bicultural education as far as science education is concerned. The first of these is the interplay between language and concept formation. Since many children are exposed to science in English at a level above their language competence, they never understand the scientific concepts involved. They certainly do not acquire the skills of inquiry or creative problem-solving that can effectively equip them to function in a highly technological society, such as that of the United States, neither at a practical level nor at a professionally technical level.

A second factor is that the mainstream science materials often are based on remote examples that minority children cannot relate to easily. In the upper grades, scientific concepts become very complex, as do the language structures in English necessary to verbalize about and understand the concepts. Thus, students who have a low level of mastery of English in the upper-elementary grades lose out on important scientific concepts and inquiry processes that are fundamental for more advanced science work.

This paper suggests that an inquiry approach to science instruction with the proper hands-on activities could improve the bilingual/bicultural program by: (1) focusing more on cognitive

operations and problem solving, (2) improving language skill in both languages, and (3) consequently providing better opportunities for limited English proficient children to participate in advanced science studies. Exactly how these three goals might be achieved in bilingual education is suggested later in this paper by a problem-solving model for integrating science and language. To some extent, this model could also be applied to other content areas such as social studies or math; however, these areas are beyond the scope of this paper.

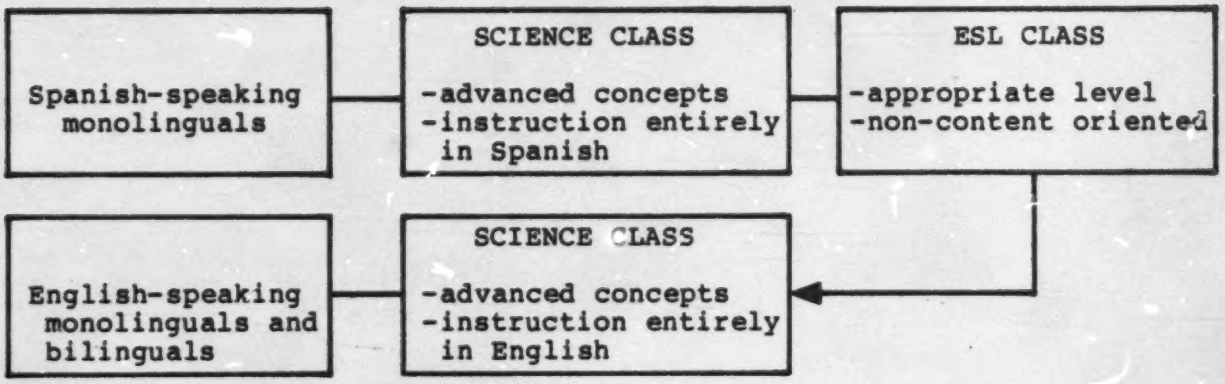
MODELS FOR INTEGRATING SCIENCE AND LANGUAGE

We can distinguish at least three alternative curriculum models for integrating science and language that currently exist. Although these are basically hypothetical models imagined for the sake of discussion and in order to contrast with our own integrative model, we feel that each model exists to some extent in some schools in the United States or Canada. For the sake of discussion, we will refer to these models as follows: the **transfer** model, the **balanced bilingual** model, and the **ESL** model. Our own model will be referred to as the **integrative** model.

The **transfer** model is entirely designed for limited English proficient students who enter fourth, fifth, or sixth grades with competence in only Spanish. The focus of this model (Figure 1) is to provide science instruction in Spanish with fairly advanced concepts until the students are able to function somewhat with English and can subsequently be transferred into English-speaking science instruction classrooms. Thus, the transfer model

Figure 1

THE TRANSFER MODEL

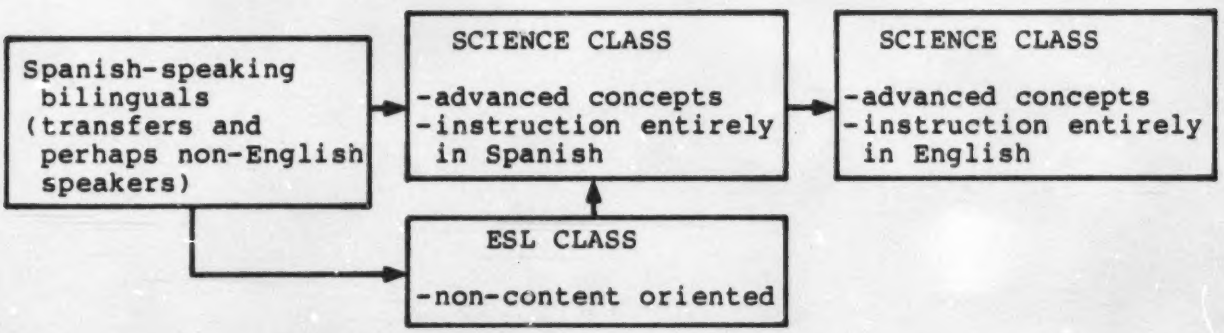


is basically a temporary procedure to deal with limited English speakers or incipient bilinguals. As the diagram illustrates, the ESL instruction in the transfer model is not coordinated with any particular content area such as science or math, although the teacher may draw on these areas occasionally. The transfer model may often attempt to maintain content continuity in the curriculum by teaching the same concepts for each grade (fourth, fifth, or sixth) but in different languages for different student populations. Thus, a student, hypothetically, is easily moved from science instruction in Spanish in fourth grade to science instruction in English in fifth grade once the necessary English language skills have been acquired. In short, the transfer model is really a temporary method for integrating the limited English proficient population into mainstream English courses as soon as feasible.

The balanced bilingual model seeks to devote equal time to science in both English and the native language through separate classes. This model is no doubt fairly uncommon in the United States, although it may be utilized in Canada. The order in which these two classes occur is ultimately the key, since the notion is that limited English proficient students should first learn and understand the scientific concept in their dominant language and then later be introduced to the same material in English. This model (Figure 2) obviously seeks to develop English language skills in science classes while not sacrificing the acquisition of the scientific concept first in the dominant language.

Figure 2

THE BALANCED BILINGUAL MODEL



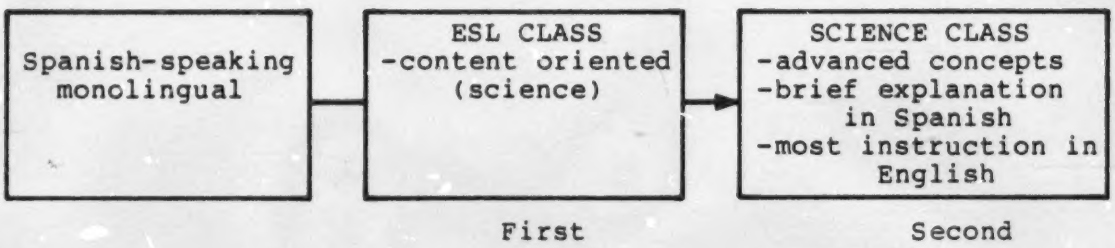
The balanced bilingual model is designed for limited English proficient students in all three upper grade levels (fourth to sixth) with primary focus on learning the inquiry processes and

concepts through their native language along with reinforcement of the same processes or concepts and improvement of English competence later in the day through science instruction in English. ESL classes are designed as optional but required for less proficient English speakers and perhaps transfers, if needed.

The third hypothetical model, the ESL model, is aimed at helping the less proficient English speaker or non-English speaker to receive science education in English, but only after proper preparation in ESL content. The ESL model (Figure 3) is currently applied in an experimental program funded under Title VII at Roosevelt School, El Paso, Texas (Apodaca, 1981). This model requires a great deal of coordination between ESL teachers and science teachers, using a minimum of Spanish to explain the basic concept and a maximum of English in the classroom. As Figure 3 reflects, a typical daily schedule for each grade level fourth through sixth) of limited English proficient students includes a science-oriented ESL class followed by a science class predominantly in English. Incidentally, the same routine is followed for social studies and math.

Figure 3

THE ESL MODEL



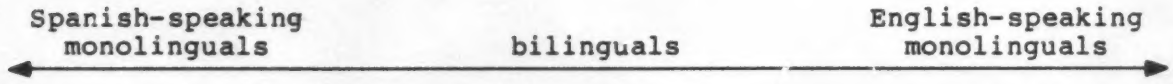
Through coordination between the ESL and science instructors, the ESL model seeks to give the students the English structures and vocabulary necessary for the science class that follows. The science class is first taught briefly in Spanish and then in more detail in English. The concepts introduced in science class in the ESL model are the same concepts introduced in English to monolingual/dominant English speakers. In short, the ESL model utilizes the notion of ESL in the content areas to prepare students for a science lesson conducted primarily in English. It is obvious that this model would have some difficulty in encouraging inquiry development in Spanish, since the focus of the model is functioning in English for the most part.

AN INTEGRATIVE PROBLEM-SOLVING MODEL

In the hypothetical models discussed previously, we note some similarities as well as some problems for an inquiry approach to teaching science. First, none of the hypothetical models have included similar components for the monolingual or proficient English speakers. There is no suggestion for treating Spanish as a Second Language (SSL) for English speakers as there is for ESL for Spanish dominant speakers. Secondly, the inquiry approach would be problematic in most models, since it is based on a great deal of verbalization on the part of the children, often at a linguistically complex level. At least for the advanced scientific concepts, students who are limited English proficient would not be able to function in English through a truly inquiry approach as many of the models have suggested. However, they might possibly

function at a less advanced or beginning science level through the use of English. In fact, as we are suggesting in our integrative model, scientific inquiry at less advanced stages can be used to teach a second language, whether Spanish or English, while the dominant language can be used to teach science at the more advanced inquiry stages appropriate to the level of the children involved. Our model spells out specifically how language skill in the dominant language and the second language might be synchronized and mutually supportive with science learning in a way relevant to the Latino culture.

In order to be adaptable to a variety of sociolinguistic situations represented in bilingual education programs throughout the United States, the integrative model assumes three hypothetical, categorical points along a language proficiency continuum:



At one end of the continuum are the monolingual Spanish speakers; at the other, the monolingual English speakers; and in the middle are the bilinguals who are either knowledgeable in both Spanish and English or who need work in both formal Spanish and formal English. These are, of course, simply imaginary distinctions since in real life a community or a classroom certainly may have children who range from monolingual Spanish speakers to dominant Spanish speakers to balanced bilinguals to dominant English

speakers with some knowledge of Spanish to monolingual English speakers (Ornstein et al., 1975). School systems, just as classrooms, often have this same array; but for the sake of our model, we are going to imagine three main groups of students in grades four through six: (1) dominant Spanish speakers who need ESL; (2) balanced bilinguals who have fluency in certain domains in English and Spanish, can read in both languages, but may have greater vocabulary and structural language development in certain content areas for one language versus another; and (3) dominant English speakers who may or may not know a little Spanish and are in a program of Spanish as a Second Language (SSL) or Spanish as a Foreign Language. It will be assumed that bilinguals who may not be able to read in both languages, i. e., who are not balanced, would be placed in the first group.

The three categories mentioned above are typical of three separate classes or, in some cases, of one linguistically heterogeneous classroom. Our model would function within a classroom situation in which the three groups work separately or within an entire school setting in which each group would consitute a different class and be handled separately. The latter is, of course, preferable.

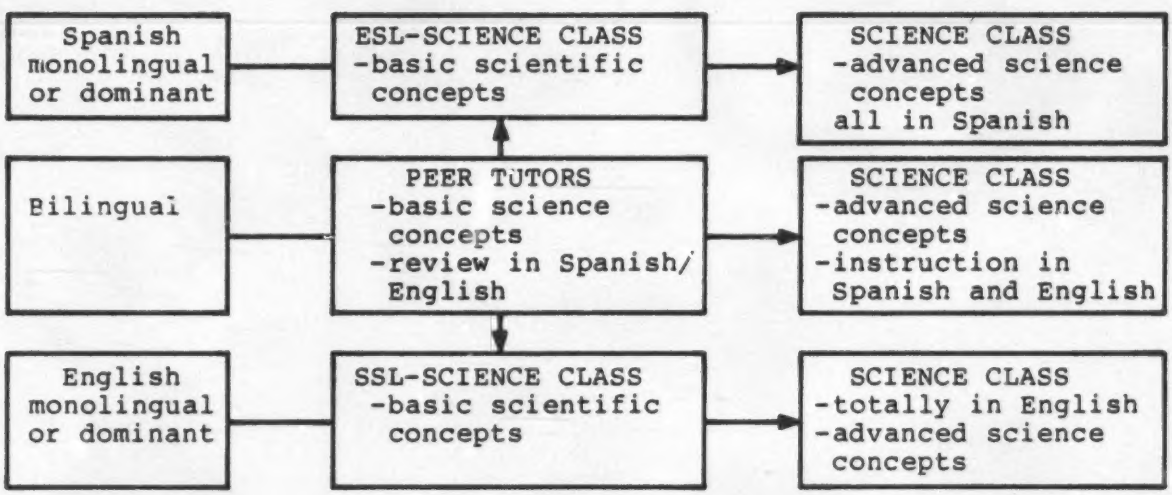
Although the three categories of students distinguished above may be quite different linguistically, we can assume that they are all in need of scientific concepts and development in problem-solving and inquiry. At the same time, it might also be assumed that each group may have different levels of preparation and background in scientific inquiry processes. Because of the linguistic

situation, it is often the case that monolingual Spanish speakers or dominant Spanish speakers lack the knowledge of technical scientific terms in Spanish. Therefore, it might be necessary to emphasize these terms in the science classes taught in the dominant language.

Figure 4 illustrates the sequence to be followed with the three groups mentioned previously so that a full integration of second language and science classes can be achieved, given the linguistic nature of the students involved.

Figure 4

THE INTEGRATIVE MODEL


Spanish monolingual or dominant
ESL-SCIENCE CLASS -basic scientific concepts
SCIENCE CLASS -advanced science concepts all in Spanish
Bilingual
PEER TUTORS -basic science concepts -review in Spanish/ English
SCIENCE CLASS -advanced science concepts -instruction in Spanish and English
English monolingual or dominant
SSL-SCIENCE CLASS -basic scientific concepts
SCIENCE CLASS -totally in English -advanced science concepts

The integrative model includes several unique aspects. First, the integration of bilinguals in both second language learning settings is suggested to facilitate interpersonal communicative language acquisition. Thus, bilinguals act as peer tutors to second language learners and at the same time receive

review in concepts as well as terms used in both Spanish and English for these concepts. This is in keeping with research on language acquisition among children which reveals that actual communication as opposed to formal language instruction is more beneficial for children below puberty (grades four through six).

The integrative model is basically utilizing the immersion language learning concept that focuses on actual language communication and use in content areas as opposed to language instruction in non-content oriented areas. The integration of two very different sets of students proposed by our model provides a sort of immersion quality to the SSL and ESL language program while at the same time facilitating the review of simple scientific concepts, e. g., color terms, terms for shapes, texture, size, temperature differences, direction, movement, taste, and length.

A second unique aspect of the integrative model is the use of science-oriented materials to teach the second language. This notion is a fairly uncommon one, although a few bilingual educators have proposed it in detail (Sutman et al., 1979).

Using science to teach ESL/SSL is a very sensible notion that offers educators an opportunity to kill two birds with one stone. In the first place, as discussed previously, the learning is furthered through manipulation and internalization processes in language learning in natural situations as well as cognitive operations as defined by Piaget (Walsh, 1971) and Montessori (1976). A scientific inquiry approach to learning science offers this opportunity for both language learning and inquiry growth. The use of hands-on materials which children can manipulate, observe, and

comment about provides the basis for sensory-motor learning of language and science.

The third unique aspect of our proposed model, and one that varies from the practice of most bilingual programs, is the actual directions in which the model proceeds. Some models seek only to help the Spanish dominant or monolingual Spanish-speaking child function eventually totally in English. These models are essentially unidirectional and their focus is essentially on the non-English proficient student. It is interesting to note that our integrative model seeks to be truly bidirectional and bilingual in that we are not only concerned with providing opportunities for ESL through science but also SSL through science.

In many models Spanish dominant students are prepared in ESL essentially to join science classes instructed in English and all too often this means they join English dominant or monolingual English-speaking peers. This situation can be problematic and psychologically damaging for the less proficient English speakers who are always somewhat behind their peers because of language differences. We can imagine this to be the case especially with an inquiry approach to science, since this approach involves problem solving through verbalization. The ESL model, for example, involves preparing students in ESL classes to understand the structures and terminology they will encounter later in a science class taught mostly in English. The integrative model is quite different in this respect. It attempts to ensure acquisition of the scientific concepts through the dominant language, thus

avoiding the problem posed by other models in which language becomes a barrier to scientific understanding.

In contrast to the ESL model, the integrative model first builds on linguistic structures through basic scientific concepts in the second language. Complex scientific concepts are taught in the student's dominant language at the same time. Thus, our model is directed at teaching a second language, either English or Spanish, through fundamental knowledge of science--rather than through complicated conceepts. Our goal is to teach ESL/SSL **through** science not to teach ESL **for** science. On the other hand, science classes focusing on more advanced concepts and inquiry processes are instructed in the dominant language to assure maximum acquisition by each population of students involved. Since the inquiry approach requires a variety of different linguistic structures, such as the ability to ask questions, make statements, understand more complex directions, and make generalizations, our model tries to ensure a competent grasp of linguistic complexities before introducing advanced scientific concepts. In addition, the integrative model is broader in scope than the hypothetical models discussed previously, in that it attempts to deal with a variety of different populations and communities through bidirectionality.

It should be noted that the integrative model could be applied equally to other content areas: math, social studies, etc. We have chosen science for this paper because we feel this area offers a unique opportunity for matching concrete materials and visual aids with language structures. Second language

instruction depends heavily upon direct use of pictures and other visual aids for teaching specific language structures. Math and social studies involve concepts that are not as easily related through pictures or visual aids that match specific linguistic structures. For example, the present perfect structure in English--not commonly used in Spanish--might easily be learned through active experiments involving change, e. g., "How has the plant changed?" "It has grown one inch."

On the other hand, science tends to focus on specific linguistic structures and vocabulary (see Appendix A and B). This means that not all language skills can be covered through science. There are limitations, as the analysis of a variety of necessary structures and vocabulary items reveals (Appendix A and B). Still, science does offer an opportunity to understand and learn how to use these through concrete manipulation and verbalization.

ANALYSIS OF AVAILABLE HANDS-ON MATERIALS

There are a wide number of materials that are inquiry or process oriented for science teaching; however, very few of these are available for bilingual educational models such as the one we have proposed. Even bilingual science materials available (Rey, no date) are not written for Southwest Spanish speakers. Thus, even those materials written for bilingual classrooms may not use vocabulary terms appropriate to the populations involved. Consequently, it might be wiser for teachers to use hands-on materials written in English for teacher use and develop equivalents in

Spanish. The development of hands-on materials for bilingual/bicultural science classes must also adapt to the ethnic/cultural background of students in order to facilitate maximum internalization of concepts. For example, to develop the inquiry process of classification for Mexican-American children in the Southwest (and Anglo children, too, to some extent), the use of deciduous trees and/or leaves might be less relevant than desert fauna or cacti. The development of linguistic terms, such as "hot" and "spicy" probably would involve different examples of food items for Mexican heritage students than for most Anglo students.

In this connection, it must be emphasized that all too many colleagues over-simplify the matter of terminology, assuming that appropriate Spanish equivalents are those found in any standard school dictionary. In reality, there are 19 national varieties of Spanish as well as regional dialects in each nation of the Hispanic world, including the United States. Puerto Rican, Cuban, and Chicano Spanish reflect sharp differences in lexical and phonological type with much less divergence in grammar and syntax. Ornstein (1981) discusses the sociolinguistic nature of varieties of Spanish in the United States. Bilingual teachers must accommodate to the respective national/regional varieties, whether Spanish or other languages, so that "dialect" words or phrase types can be readily supplied, ensuring learners can readily grasp meanings and avoid confusion. Unfortunately, bilingual teacher training still tends to deal with the linguistic component in a cavalier fashion, emphasizing abstract linguistic principles rather than basing such components on the problems encountered as

a result of language variation in actual domains of living, the school being one of the most crucial. One of the few glossaries of science terminology is one prepared by Ortiz and Davila (1979) as a project in a course in the framework of the Bilingual Teacher Training Program at Texas A. and I. University.

One set of materials, which is process oriented and organized into 105 modules for teaching science, might best work for this adaptation, especially since the materials are primarily for the teachers in guiding students. **Science: A Process Approach II** (American Association for the Advancement of Science, 1976) is a module approach that gets progressively more complex and cumulative in scientific understanding. Although only the first few kindergarten modules are translated into Spanish, it would probably not take a great deal of effort to adapt further modules to a Spanish-speaking classroom. Much of the method involves verbal guidance by the teacher.

An analysis of the above materials reveals that the following basic scientific concepts are covered at various levels:

1. Observation;
2. space/time relationships: shapes, directions, motions, and speed;
3. Classification: similarities/differences of objects and events;
4. Numbers: ordering, counting, and mathematical operations;
5. Measurement: using instruments and selecting correct instruments;
6. Data interpretation: inferring from diagrams, maps, and graphs;

7. Variable identification: observing, recording, and manipulating changes;
8. Forming hypotheses; and
9. Making operational definitions.

An analysis of the linguistic structures and vocabulary needed for various modules was carried out by the authors. As Appendices A and B reveal, each module requires a great variety of structures and terms despite the language involved.

It becomes apparent from an analysis of the entire array of 105 modules that the first set of modules (1-15), which are intended for kindergarten, provide excellent material for linguistic development in a second language along with a basic scientific concept. For example, Module 1 focuses on observational skills, specifically the naming and identification of colors. The students are to name and identify all primary colors. This activity would require not only the terms for primary colors but also the linguistic structures for asking about colors, commenting about objects with colors, and commenting generally about color. The example below illustrates the structures necessary in Spanish and English to do this.

What color is this?	¿De qué color es este?
It's green . (color)	Es verde . (color (in agreement))
What color is the top?	¿De qué color es el trompo?
It's a red top. (color)	Es un (article) trompo rojo . (color (in agreement))

We can see by the examples of linguistic structures necessary that the child learning English must learn two new linguistic concepts: (1) the adjective precedes the noun, and (2) a pronoun is obligatory in the statement. The child learning Spanish must learn at least three linguistic concepts: (1) a pronoun (subject) is optional; (2) adjectives follow the noun; and (3) articles and adjectives must agree with the noun, except for special adjectives like **azul** or **verde**.

It is apparent that although Module 1 may have been designed for kindergarten monolinguals or even younger children, it can usefully serve beginning second-language students (grades four through six) and for introducing scientific concepts. Our integrative model could easily utilize the very basic modules to integrate science and second-language learning. What better way of introducing qualitative concepts than through actual touching, seeing, smelling, or other actions along with verbalization. Often certain terms and their concepts cannot effectively be explained other than through actual experience. Certain qualities in English illustrate this problem:

TASTE--sweet/bitter/sour

DENSITY--hard/soft

TEXTURE--smooth/rough

WEIGHT--heavy/light (not for colors, speed, or density)

COLOR--dark/light

Thus, the linguistic restrictions on labeling scientific concepts are defined by the particular language. Much of the confusion from the second language learner's viewpoint can be eliminated by

using concrete and explicit objects that define the distinctions of contrasting labels or structures.

In short, the beginning modules of the **Science: A Process Approach II** series require students to identify and name a variety of basic fundamental concepts: number, color, shape, size, texture, temperature, direction, spatial position, serial order, dimension, measurement, sound, and sequence of events. All of these concepts require basic linguistic notions that can be taught along with the concepts to second language learners using the proper hands-on materials, which are culturally relevant and semantically revealing. In fact, Modules 1-17 can be used to teach basic second language constructs to beginning fourth to sixth grade students. The more advanced modules offer some opportunity for language learning, however, their increased complexity makes them less adaptable to this purpose.

CONCLUSION

This paper has offered a model for integrating science and language in bilingual/bicultural education with the goals of increasing cognitive operations as well as language skills in both languages for a variety of different populations. The integrative model suggests how the broad stages of inquiry can be integrated with language. Finally, this paper suggests ways in which hands-on materials need to be adapted to fit the needs of various ethnic groups and linguistic groups of the proposed integrative model.

REFERENCES

Agnello, Ninfa. "Learning Science Through Doing," **Newsletter**, II, No. 3 (1980). (Arlington Heights, Illinois: Bilingual Education Service Center.)

American Association for the Advancement of Science. **Science: A Process Approach II.** Rev. ed. New York: Ginn and Company, 1976.

Apodaca, Rosita. Personal communication regarding the Roosevelt School Project, Title VII, 1981.

Montessori, Maria. **From Childhood to Adolescence: Including Erdkinder and the Function of the University.** New York: Schocken Books, 1976.

Ornstein, Jacob. "Varieties of Southwest Spanish: Some Neglected Basic Distinctions," **Latino Language and Communicative Behavior**, ed., Richard P. Duran. Norwood, New Jersey: Ablex Publishing Corporation, 1981.

_____, Guadalupe Valdes-Fallis, and Betty Lou Dubois. "Bilingual Child Language Acquisition Along the U.S.-Mexican Border: The El Paso-Ciudad Juarez-Las Cruces Triangle," **Child Language**, ed., Walburga von Raffler-Engel. New York: International Linguistic Association, 1975.

Ortiz, Narciso, and Gloria Davila. **Vocabulario Cientifico: Tercer Grado.** Kingsville, Texas: Texas A and I University, School of Education, 1979.

Rey, Luis. **Ciencas 2, 3, 4, Rey.** Cultural Centroamericana: SA Ediciones y Distribucienes Codice, no date.

Sutman, Francis X., Eleanor L. Sandstrom, and Francis Shoemaker. **Educating Personnel for Bilingual Settings: Present and Future.** Washington, D. C.: American Association of Colleges for Teacher Education and Multilingual Education Resource Information and Training Center (MERIT), 1979.

Walsh, Beatrix, trans. **Biology and Knowledge: An Essay on the Relations Between Organic Regulations and Cognitive Processes**, by Jean Piaget. Chicago, Illinois: University of Chicago Press, 1971.

RECOMMENDED READINGS

Asher, James J. "The Learning Strategy of the Total Physical Response: A Review," **Modern Language Journal**, L, No. 2 (February, 1966), 79-84.

_____. "The Total Physical Response Approach to Second Language Learning," **Modern Language Journal**, LIII, No. 1 (January, 1969), 3-17.

Cartieri, Graham, and R. Tremblay. "The Use of Concrete Mathematical Situations in Learning a Second Language: A Dual Learning Concept," **Bilingual Multicultural Education and the Professional**, eds., Henry T. Trueba, and Carol Barnett-Mizrahi. Rowley, Massachusetts: Newbury House, 1969.

Chavez, Luisa C. "Jean Piaget's Theory of Equilibration Applied to Dual Language Development," **Theory in Bilingual Education**, ed., Raymond V. Padilla. Ethnoperspectives in Bilingual Education, Research Series, Vol. II. Ypsilanti, Michigan: Eastern Michigan University, Bilingual/Bicultural Programs, 1980, pp. 148-158.

Elkins, Robert J., Theodore B. Kalivoda, and Genelle Morain. "Teaching Culture Through the Audio-Motor Unit," **Foreign Language Annals**, VI, No. 1 (October, 1972), 61-67.

Hernandez, Norma G. "Variables Affecting Achievement of Middle School Mexican-American Students," **Harvard Educational Review**, XLIII, No. 1 (Winter, 1973), 1-39.

Kessler, Carolyn, and Mary Ellen Quinn. "Bilingualism and Science Problem-Solving Ability," **Bilingual Education Paper Series**, Vol. 4, No. 1. Los Angeles, California: National Dissemination and Assessment Center, California State University, Los Angeles, August, 1980.

Lopez, Ronald W., Arturo Madrid-Barela, and Reynaldo Flores Macias. **Chicanos in Higher Education: Status and Issues.** Monograph #7, Chicano Studies Center Publication, University of California, Los Angeles, 1976.

Mackey, William F., and Jacob Ornstein. **The Bilingual Education Movement.** El Paso, Texas: Texas Western Press, 1976.

Muhs, William F., Gary Popp, and Herman F. Patterson. "The Mexican-American in Higher Education: Implications for Educators," **Personnel and Guidance Journal**, LVIII (September, 1979), 20-24.

Ornstein, Jacob. "New Accents in Foreign Language Teaching," **Intellect Magazine**, CIII, No. 2364 (March, 1975), 395-398.

Singer, Dorothy G., and Tracey A. Revenson. **A Piaget Primer: How a Child Thinks.** New York: New American Library, 1978.

Appendix A

VOCABULARY

Shapes	Figuras
circle	círculo (m.)
cone	cono (m.)
cube	cubo (m.)
cylinder	cilindro (m.)
ellipse	elipse (f.)
line	línea (f.)
oval	óvalo (adj.)(m.)
pyramid	pirámide (f.)
rectangle	rectángulo (adj.)(m.)
round	redondo(a) (adj.)
square	cuadrado (adj.)(m.)
triangle	triángulo (adj.)(m.)

Colors	Colores (m.)
red	rojo(a)
yellow	amarillo(a)
blue	azul
black	negro(a)
white	blanco(a)
brown	café
green	verde
orange	anaranjado(a)

Sound	Sonido
loud	fuerte
soft	no muy fuerte
high-pitch	alto(a)
low-pitch	bajo(a)
long	largo(a)
short	corto(a)

Texture	La Textura
rough vs. smooth	aspero(a) vs. liso(a)
shiny vs. dull	brillante vs. empañado(a)
sharp vs. blunt	filoso(a) vs. falto de filo (obtuso)
wet vs. dry	mojado(a) vs. seco(a)
damp	húmedo(a)

Appendix (continued)

	Size	Tamaño
everything:	big vs. small	grande vs. pequeño(a), chico(a)
things:	long vs. short vs. medium	largo vs. corto(a) vs. medio(a)
people:	tall vs. short	alto(a) vs. bajo(a)
things:	narrow vs. wide	estrecho(a) vs. ancho(a)
objects:	light vs. heavy	ligero(a) vs. pesado(a)
	thick vs. thin	grueso(a) vs. delgado(a)
	full vs. empty	lleno(a) vs. vacío(a)
	half-full	medio-lleno(a)
	fast vs. slow	rápido vs. despacio
	deep vs. shallow	profundo vs. poco profundo

	Hair Color	Color de Pelo
	blond	rubio(a)
	brunette	café obscuro
	red head	pelirojo(a)

	Taste	Sabor
	bitter	amargo(a)
	sweet	dulce
	sour, acidy	ácido(a), ágrio(a)
	bland	sin sabor
	spicy	condimentado
	hot	picante
	salty	salado(a)

	Weather	El Tiempo
	climate	el clima
	windy	airoso(a) (hacer mucho viento)
	cloudy	nublado(a)
	sunny	asoleado(a) (hacer mucho sol)
	hot	caluroso(a)
	cold	frío(a)
	snowy	nevado(a) (estar _____)
	rainy	lluvioso(a) (un día _____)
	humid	húmedo(a)
	stormy	tempestuoso(a)
	clean	despejado(a)
	solid	sólido (adj.)(m.)
	liquid	líquido (m.)
	gas	gas (m.)

Appendix A (continued)

Measures	Medidas (f.)
degrees	grados
centigrade	centígrados
quart	cuarto de galón (m.)
pound	libra (f.)
pint	pinta (f.)
ounce	onza (f.)
gallon	galón (m.)
volume	volumen (m.)
velocity	velocidad (f.)
force	fuerza (f.)
density	densidad (f.)
width	anchura
height	altura
depth	profundidad
length	largo

Appendix B

STRUCTURES

Concept	Structure	
EQUIVALENCY	1. Y* is the same as X*.	Y es igual a X. (Y y X son iguales.)
	2. Y smells the same as X.	Y huele igual que X. (Y y X huelen iguales.)
	3. Does Y smell the same as X?	¿Huele Y igual que X? (¿Huelen iguales Y y X?)
	4. Y isn't the same as X.	Y no es igual que X.
	5. Is Y as (adj.) as X?	¿Es Y tan (adj.) como X? agreement
	6. Does Y have the same SHAPE as X?	¿Tiene Y la misma FORMA que X?
EXEMPLIFICATION (observation)	1. What is an example of a(n) (adj.) X?	¿Qué (Cuál es un ejemplo de un X (adj.)? agreement
QUALITIES	1. What's the weather like?	¿Qué tiempo hace?
	2. What was the weather like?	¿Qué tiempo hizo?
	3. It's a (adj.) day.	Es un día (adj.). agreement
CONSERVATION	1. Y is (compar.) than X. "bigger"/"more extended"	Y es más (comp.) que X. adj. agreement
	2. How is Y different from X?	¿Cuál es la diferencia entre Y y X?
	3. How has Y changed?	¿Cómo ha cambiado Y?

*X and Y = singular nouns.

Appendix B (continued)

Concept	Structure	
CLASSIFICATION	1. Is Y a type of X ?	¿Es Y una clase de X ?
	2. How are Y and X alike?	¿En qué se parecen Y y X ?
	3. How are Y and X different?	¿En qué no se parecen Y y X ?
	4. Both of them are X	Los dos son X .... (estos dos son)
	5. All of these are X	Todos(as) los(las) son X .... (plural)
	6. We all are X	Nosotros(as) todos(as) somos X ....
ABSOLUTE QUANTITY	1. How much X is there? (non-count) How many X are there? (count)	¿Cuánto(a) X hay? (sing.) ¿Cuántos(as) X hay? (plural) (¿Qué tantos(as) hay/estan?)
	2. How long is X ? (sing.) How long are X ? (plural)	¿Qué tan largo es X ? (sing.) ¿Qué tan largos son X ? (plural)
	3. How much does X weigh?	¿Cuánto pesa X ?
	4. How tall is X ?	¿Qué tan alto(a) es X ?
	5. How much does X cost? It costs Y .	¿Cuánto cuesta X ? Cuesta Y .
RELATIVE QUANTITY	1. Which is adj. ? (comparative)	¿Cuál es más (adj.)?
	2. Which is adj. ? (superlative)	¿Cuál es lo más (adj.)?
	3. Is y or X adj. ? (comparative)	¿Es y más (adj.) que X ?
	4. Are there (fewer) Y than X ? (less)	¿Hay menos Y que X ?
	5. Which X is first? Which X is last?	¿Cuál X esta primero? ¿Cuál X esta al último?
	6. The X is adj. than the Y . (comparative)	El X es más (adj.) que el Y .

Appendix B (continued)

Concept	Structure	
MANIPULATION	1. What has happened?	¿Qué pasó?
	2. It was _____.	Era _____.
	3. Now it's _____.	Ahora es _____.
	4. How has X changed?	¿Cómo ha cambiado(a) X ? (agreement)
	5. How will X change?	¿Cómo cambiará X ?
	6. What is inside?	¿Qué está adentro?
	7. It might be _____. (could)	Podría ser _____.
	8. The X verb the Y . (simple past)	X verbo Y . (simple past)
	9. The Y was verb by the X . (past participle)	Y verbo por X . (reflexive)
	10. If the X verb , the Y will verb . (present / infinitive)	Si el(la) X verbo , el(la) X verbo . (present / infinitive)
	11. Which direction is X moving?	¿En qué dirección se mueve X ?
	12. It's moving backward / forward / to the left / to the right / back and forth .	Se esta moviendo para atras / para adelante / a la izquierda / a la derecha / para atras y para adelante .
OBSERVATION (description)	1. What color is X ?	¿De qué color es X ?
	2. What shape does X have?	¿De qué forma es X ?
	3. What shape is this?	¿Qué clase de figura es este?
	4. How big is X ?	¿Qué tan grande es X ?
	5. What size is X ?	¿De qué tamaño es X ?
	6. How does X taste?	¿Cómo sabe X ?

Jacob Ornstein-Galicia was born in Cleveland, Ohio, and received his PhD in Hispanic Studies from the University of Wisconsin.

Dr. Ornstein-Galicia has taught at Georgetown University and New Mexico State University. He is professor emeritus at the University of Texas at El Paso, where he co-founded the Cross-cultural Southwest Ethnic Studies Center, of which he is now an associate.

He has co-authored over 200 articles and is the author or editor of more than 15 books, including **Bilingual Education Movement: Essays on Its Programs** (with William F. Mackey); **Bilingualism and Bilingual Education: New Readings and Insights** (with Robert St. Clair); and the only existing book on program instruction for foreign languages, **Programmed Instruction and Education Technology in the Language Teaching Field.**

Joyce Penfield trained teachers in Nigeria for two years and is currently a lecturer at the University of Texas at El Paso.

She received her BA in French and Spanish Education from Illinois State University, MA in Linguistics from The American University in Washington, and PhD in Linguistics from State University of New York.

Dr. Penfield has published in the field of sociolinguistic investigation of language variation, especially Mexican-American English and innovative methods in teaching and curriculum for ESL and bilingual education.